**DRAFT 1**

***Printer/Fax/Mailing Machine Memorandum of Understanding (Version 3.0)***
***between The United States Environmental Protection Agency***
***and***
***COMPANY NAME***

## I. Common Agreements and Principles

A. This is a voluntary agreement between [Company] ("ENERGY STAR® [1] Partner" or "Partner") and the United States Environmental Protection Agency (EPA), by which [Company] joins the ENERGY STAR Program. The terms of this MOU shall apply to printers, facsimile (fax) machines, combination printer/fax machines, and mail machines sold by Partner under its own brand name(s).

B. ENERGY STAR Partner and EPA agree that the primary purpose of the ENERGY STAR Program is to promote the use of energy-efficient products by consumers, thereby potentially reducing combustion-related air pollution.

C. ENERGY STAR Partner and EPA agree that the use of energy-efficient products reduces end user energy bills and increases profits and competitiveness for businesses.

D. ENERGY STAR Partner and EPA agree that the ENERGY STAR Program may also improve or enhance product's useful lifetime, customer satisfaction, and overall product quality.

E. ENERGY STAR Partner and EPA agree that publicizing the ENERGY STAR Program is important to demonstrate the following: the concern of Partner for the environment, the vitality of the free enterprise system in reducing costs, and the capability of voluntary programs to achieve environmental goals. ENERGY STAR Partner and EPA agree that the use of energy-efficient products reduces household energy bills and increases profits and competitiveness for businesses.

F. ENERGY STAR Partner and EPA agree that maintaining public confidence in the ENERGY STAR Program is critical to achieving the shared goals of Partner and EPA.

G. Energy Star Partner and EPA agree that the integrity of the ENERGY STAR Office Equipment Program and the ENERGY STAR logo depend on consumer recognition of the ENERGY STAR logo as a means of identifying products, in a particular market, that are more energy-efficient than conventional products. Therefore, ENERGY STAR Partner and EPA will work together to revise the technical specifications as necessary to ensure that only the most energy-efficient products qualify for the ENERGY STAR logo.

[1] ENERGY STAR is a U.S. registered mark.

H. ENERGY STAR Partner and EPA agree that membership in the ENERGY STAR Program is essential to the cooperative effort to achieve the shared goals stated above.

## II. Definitions

A. Printer: Imaging equipment, manufactured as a standard model, that serves as a hard-copy output device, and is capable of receiving information from single-user or networked computers. In addition, the unit must be capable of being powered from a wall outlet. This definition is intended to cover products that are advertised and sold as printers including printers that can be upgraded to a multifunctional device (MFD) [2].

B. Fax Machine: Imaging equipment, manufactured as a standard model, that serves as a hard-copy output device whose primary function is sending and receiving information. Plain paper fax machines are covered under this MOU (e.g., ink jet/bubble jet, laser/LED, and thermal transfer). The unit must be capable of being powered from a wall outlet. This definition is intended to cover products that are advertised and sold as fax machines.

C. Combination Printer/Fax Machine: Imaging equipment manufactured as a standard model that serves as both a fully-functional printer and fax machine, as defined in II.A and II.B above. This definition is intended to cover products that are marketed and sold as a combination printer/fax device.

D. Mailing Device: Imaging equipment that serves to print postage onto mail pieces. The unit must be capable of being powered from a wall outlet. This definition is intended to cover products that are advertised and sold as mailing machines.

E. Print Speed: Pages per minute (ppm) measures the printing speed specified in terms of monochrome text output per minute at the default resolution of the product. A print is defined as one 8.5" x 11" or A4-sized printed page of a single-spaced monochrome text output, 12 point type, Times font, 1" (2.54 cm) margins on all sides of the page. This definition is intended to cover products that produce only monochrome output, as well as products that are advertised and sold as color capable.

   For wide/large-format printers designed to handle primarily A2 or 17" x 22" paper or larger, the reproduction speed measured as A2 or A0 sized images per minute shall be converted into A4-sized print speeds, as follows: (a) One A2 page per minute is equivalent to four A4 size pages per minute; (b) One A0 page per minute is equivalent to 16 A4 pages per minute.

F. Accessory: A piece of additional equipment that is not necessary for the standard operation of the base unit, but that may be added before or after shipping in order to enhance or change printer performance. Examples of accessories include: finishers, sorters, additional paper supply devices, and duplex units. An accessory may be sold separately under its own model

[2] Note that once a printer base unit is upgraded to an MFD (for example, a photocopier unit is added), then the entire product must qualify according to the ENERGY STAR Office Equipment MFD MOU in order for the product to remain ENERGY STAR–compliant.

number, or sold with a base unit as part of a printer. It is assumed that the addition of any accessories will not substantially increase (more than a total of 10 percent for all accessories) the low-power or sleep mode power consumption of the base unit, irrespective of the power consumption of the accessories. Any accessories shall not impede the normal operation of the low-power and sleep mode features.

G. Active Mode: The condition (or mode) in which the product is producing hard copy output or receiving hard copy input. The power requirement in this mode is typically greater than the power requirement in standby mode.

H. Standby Mode: The condition that exists when the product is not producing hard copy output or receiving hard copy input and is consuming less power than when producing such output or receiving such input. Typically, in standby mode, there is no noticeable delay in the production of hard copy output.

I. Energy–Saver Mode: The condition that exists when the product is not producing hard copy output or receiving hard copy input and is consuming less power than when in a standby mode. In the energy–saver mode, there may be some delay in the production of hard copy output. However, there shall be no delay in the acceptance of information from network or other input sources. The product enters this mode within a specified time period after the last hard copy output was made.

J. Sleep Mode: The lowest power state that the product enters without actually turning off the product. In this mode both hard copy output and acceptance of information may be delayed. The product shall be able to accept information from network or other input sources. The product enters a sleep mode within a specified period of time after the last hard copy output was made or after it has entered the energy–saver mode. For products that meet the sleep mode requirements in any other mode, no further power reductions are required in order to be compliant.

K. Default Time To Energy–Saver Mode: The amount of time, after the last piece of hard copy throughput, that elapses prior to a unit entering into the energy–saver mode.

L. Default Time To Sleep Mode: The amount of time, after the last piece of hard copy throughput, that elapses prior to a unit entering into the sleep mode.

M. Duplexing: The process of producing text, an image, or a combination of text and image on both sides of a single sheet of paper.

## III. Entry Into Force and Duration

A. Both parties agree that any previously executed MOU between the parties on the subject of ENERGY STAR–compliant printers, fax machines, combination printer/fax machines, or mailing machines shall be terminated effective December 31, 1998.

B. Both parties agree that the terms outlined in this MOU shall become effective on January 1, 1999. Prior to this date, Partner may begin, at its discretion, to qualify products pursuant to Section IV.E below.

C. Both parties agree to the following schedule for phasing in the new specifications for the products contained in this MOU.

1. Models that Partner begins to ship prior to January 1, 1999, may be qualified under Section IV.B of MOU 2.0. Once such models are qualified as ENERGY STAR–compliant, they may continue to bear the ENERGY STAR logo until the models are phased out of the market (i.e., the new specifications will not apply retroactively to previously qualified products), and as long as the Partner continues its participation in the program and the product model continues to meet the specifications under which it was originally qualified (i.e., new specifications will not apply retroactively to previously qualified products).

2. Models that ENERGY STAR Partner begins to ship on or after January 1, 1999, must be qualified under the new specifications outlined in Section IV.E of this agreement. However, Partner may choose, at its discretion, to implement the new terms of this agreement prior to January 1, 1999.

D. Both parties agree that as technologies and markets change, it may become desirable to revise the specifications and/or product categories contained in this MOU. ENERGY STAR Partner and EPA agree to work together to revise the specifications and/or product categories in the MOU if and when changes in technology and/or markets make these revisions desirable and necessary. ENERGY STAR Partner and EPA also agree that a reasonable effort should be made to consider the ideas and opinions of all ENERGY STAR Office Equipment Partners and other interested parties when revising the specifications contained within this MOU.

E. Both parties agree that this agreement can be terminated or discontinued by Partner or EPA at any time, and for any reason, with no penalty. However, both parties agree that termination for noncompliance would only occur in accordance with the procedures of Section VII below.

## IV. ENERGY STAR Partner's Responsibilities

A. Reading and Understanding Logo Use Guidelines
**ENERGY STAR Partner affirms that it has read, understands, and will abide by the Guidelines for Proper Use of the ENERGY STAR® Name and International Logo. (Attachment A)**

B. Appointment of Liaison
ENERGY STAR Partner agrees to appoint a responsible representative of the company as liaison with EPA for the ENERGY STAR Program for any of the following products: Printers, fax machines, combination printer/fax machines, and mailing machines (product). Partner will notify EPA within one month of any change in liaison responsibility. **See Appointment of Liaisons. (Attachment B)**

C. Measuring and Testing Equipment

Power consumption shall be measured and tested from an AC source to the product. Partner must measure a representative sample of the configuration of all the models that it ships to the customer, but the Partner does not need to consider power consumption changes that may result from component additions made by the printer user after sale of product. **See Testing Conditions For ENERGY STAR® Measurement Of Printers And Fax Machines. (Attachment C)**

ENERGY STAR Partner agrees to perform tests according to the criteria specified in this Section, as necessary, to determine which of its product models comply with the product specifications outlined in Section IV.E below.

Partner is responsible for only applying the ENERGY STAR logo or referring to its systems that meet the ENERGY STAR criteria. Partner shall self-certify those products that it determines are compliant. Partner may submit compliant product information to EPA on a voluntary basis using the product information form, if it wishes to have such products included in the ENERGY STAR Product Listing

D. Number of Products Required

ENERGY STAR Partner agrees to market during the duration of this agreement one or more product models with power requirements that do not exceed the specifications outlined in Section IV.E below.

E. Product Qualification for the ENERGY STAR Logo

ENERGY STAR Partner agrees that only those printers, fax machines, combination printer/fax machines, or mailing machines that have the capability of entering an energy–saver mode and a sleep mode after a period of inactivity or maintain a level of power consumption at or below the level of power specified in Table 1 and Table 2, below, may qualify as ENERGY STAR–compliant. ENERGY STAR Partner agrees to set the product's default to activate the low-power state at no more than the time specified below from the completion of the last print job, or from the last job sent or received.

**Table 1: Standard Size Printers**
**(designed to accommodate primarily A4 or 8.5" x 11" sized paper)**

| Product Speed In Pages Per Minute (ppm) | Energy–Saver Mode (Watts) | Default Time To Energy–Saver Mode (Printer-Based Combination Units) | Default Time To Energy–Saver Mode (Fax Machines And Mailing Equipment) | Sleep Mode (Watts) | Cumulative Default Time To Sleep Mode |
|---|---|---|---|---|---|
| 0 < ppm ≤ 7 | ≤ 5 | ≤ 15 minutes | ≤ 5 minutes | NA | NA |
| 7 < ppm ≤ 14 | ≤ 15 | ≤ 30 minutes | ≤ 5 minutes | ≤ 5 | ≤ 60 minutes |
| 14 < ppm ≤ 30 | ≤ 20 | ≤ 30 minutes | ≤ 5 minutes | ≤ 15 | ≤ 60 minutes |
| 30 < ppm ≤ 44 | ≤ 45 | ≤ 45 minutes | ≤ 5 minutes | ≤ 15 | ≤ 60 minutes |
| 44 < ppm ≤ 100 (Including all color laser, thermal-wax, or color thermal transfer printers) | ≤ 60 | ≤ 60 minutes | ≤ 5 minutes | ≤ 20 | ≤ 90 minutes |
| 100 < ppm | ≤ 85 | ≤ 60 minutes | ≤ 5 minutes | ≤ 20 | ≤ 90 minutes |

**Table 2: Large/Wide-Format Printers**
**(designed to accommodate primarily A2 or 17" x 22" or larger paper)**

| Product Speed In Pages Per Minute (ppm) | Low-Power Mode (Watts) | Default Time To Low-Power Mode | Sleep Mode (Watts) | Cumulative Default Time To Sleep Mode |
|---|---|---|---|---|
| 0 < ppm ≤ 40 ppm | ≤ 45 | ≤ 30 minutes | ≤ 10 | ≤ 60 minutes |
| 40 < ppm | ≤ 65 | ≤ 90 minutes | ≤ 20 | ≤ 120 minutes |

1. Default Times: For all products, the sleep mode default time is the cumulative (or total) amount of time that can elapse prior to the unit entering the sleep mode. For standard sized printers (Table 1), the sleep mode default time shall be set at no more than 60 minutes after the last hard copy throughput. For large/wide format printers, the sleep mode default time shall be set at no more than the times listed in Table 2. After shipping, the ENERGY STAR Partner, designated service representative, or customer may change the default times for the energy–saver mode and/or the sleep mode, up to a factory-set maximum of 120 minutes (i.e., the combined total of both default times shall not exceed 120 minutes).

2. Duplexing: For all standard size printers above 14 ppm in which a duplexing unit is installed, it is recommended that the ENERGY STAR Partner educate its customers about using their printers with duplex set as the *default* printing mode. Education may consist of information about the appropriate printer driver and print menu setup in the product manuals, or by providing specific instructions about the printer driver when a duplexing unit is installed.

F. Customer Education

1. Identification of Qualifying Products in the Marketplace
   ENERGY STAR Partner must ensure that consumers have a quick and easy method of determining which of the Partner's printers, fax machines, combination printer/fax machines, or mailing machines are ENERGY STAR–compliant. To achieve this goal, Partner must ensure that the ENERGY STAR logo appears with the ENERGY STAR–compliant product models that are advertised on the Partner's Website. In addition, EPA recommends that Partner place the ENERGY STAR logo on all qualified models, their packaging, and product-related materials such as brochures, manuals, data sheets, and advertisements.

2. Product Literature
   Consumers must be able to identify and understand the energy-saving characteristics of the product models that the Partner qualifies as ENERGY STAR–compliant. Accordingly, Partner agrees to provide general information to users regarding the ENERGY STAR features of the qualifying products. This information may include one or more of the following: a description of the ENERGY STAR Program, a discussion of the environmental and monetary benefits of the energy-savings characteristics of the product, and a description of the benefits of duplexing (for example, reduced paper costs, decreased national energy consumption, and less paper in the waste stream). In addition, Partner shall provide information about recommended types of recycled paper that can best be used in a particular printer, including the amount of post-consumer content in the paper.[3] Partner may determine the best manner to disseminate this information to customers.

G. Employee Education
   ENERGY STAR Partner agrees to provide information and training about the ENERGY STAR Program to all of its employees whose jobs are relevant to the development, marketing, sales, and service of ENERGY STAR–compliant products. This information and training is necessary to ensure that such personnel are familiar with the goals and operational aspects of the program. Partner may determine the best manner to provide this information and training to its employees.

H. Information Sharing
   At EPA's request, Partner will attempt to locate customers that have purchased ENERGY STAR–compliant products and are willing to share information about performance and savings. In addition, Partner will attempt to identify employees who have contributed to the Partner's success in the ENERGY STAR Office Equipment program. This customer- or employee-supplied information is to be without reference or endorsement of specific Partner, specific products, or other supply sources.

[3] As directed by Executive Order 12873, §504, Part A, the U.S. Government has specified a minimum of 30% post-consumer content (effective December 31, 1998) for all paper purchased for government use. Partner may wish to include information on this or other types of recycled paper.

I. Endorsement

ENERGY STAR Partner agrees that it will not construe, claim, or imply that its participation in the Program constitutes EPA approval, acceptance, or endorsement of anything other than Partner's commitment to the Program. Partner understands that participation in the ENERGY STAR Program does not constitute EPA endorsement of ENERGY STAR Partner or its products. In addition, since the EPA will not officially approve any individual test reports submitted by Partner, Partner may not include misleading statements in product literature or sales presentations that imply a product is approved or certified by the EPA. For example, Partner shall not make claims such as "This printer is EPA-approved," "This printer is EPA-certified," or any similar statement intended to convey an EPA endorsement.

J. Energy-Saving Features and Product Performance

ENERGY STAR Partner agrees to ensure that the energy-saving features or design of the ENERGY STAR–compliant product will not interfere with or adversely impact the performance of the product.

K. Voluntary Actions

ENERGY STAR Partner agrees that the activities it undertakes connected with this MOU are not intended to provide services to the federal government and that Partner will not submit a claim for compensation to any federal agency.

**V. EPA's Responsibilities**

A. Appointment of Liaison

EPA agrees to designate a single liaison for the ENERGY STAR Program, and to notify Partner within one month of any change in liaison responsibilities. Please send the signed MOU and other correspondence to this person. **See Appointment of Liaisons. (Attachment B)**

B. Product Testing

EPA agrees to accept the certification by the Partner, whether it is self-determined or determined by an independent third party, that its qualifying product models satisfy the specifications set forth in this MOU. While this is a self-certifying process, EPA reserves the right to conduct tests on products bearing the ENERGY STAR logo from either the open market or other available sources. EPA may request Partner to voluntarily provide products to be tested by EPA.

C. Consumer Acceptance

EPA agrees to make an effort to encourage consumer acceptance of products introduced under this agreement and bearing the ENERGY STAR logo.

D. Public Recognition

EPA agrees to provide Partner with recognition for its public service in protecting the environment by performing analyses about the pollution prevented by corporate participants, and providing this and other program information to appropriate news media sources for publication.

E. Consumer Education
EPA agrees to promote energy-efficient products, and to inform consumers about the ENERGY STAR Program and the ENERGY STAR logo by writing articles and/or by cooperating with the news media by sharing information, where appropriate.

F. Public Service Advertisements
EPA agrees to work with Partners to coordinate the placement of advertisements to promote energy-efficient products, educate consumers about the ENERGY STAR Program and logo, and provide Partners with due recognition for their public service in protecting the environment

## VI. Use of the ENERGY STAR Logo and Name

A. Associating Logo with Qualifying Models
It is the responsibility of the Partner to associate EPA, the ENERGY STAR logo and name, and the ENERGY STAR Program only with those specific models that qualify under the terms and conditions of this MOU. **See Guidelines for Proper Use of the ENERGY STAR® Name and International Logo (Attachment A).**

B. ENERGY STAR Materials
EPA agrees to loan Partner, at no charge, materials from which Partner can reproduce the ENERGY STAR logo.

C. Referring to the ENERGY STAR Logo
When the ENERGY STAR logo is used, Partner agrees that it shall be accompanied by the following statement: "As an ENERGY STAR® Partner, COMPANY~ has determined that this product meets the ENERGY STAR® guidelines for energy efficiency." When the ENERGY STAR logo is applied directly to the product or product packaging, Partner may place this statement in the user's manual. **See Guidelines for Proper Use of the ENERGY STAR® Name and International Logo (Attachment A).**

D. Registered Marks
ENERGY STAR Partner understands that the ENERGY STAR® name and the ENERGY STAR logo are registered marks of the United States Environmental Protection Agency, and are subject to the provisions of Title 15, Chapter 22, United States Code, the various state laws applicable to trademarks, and this Memorandum of Understanding. As such, the Partner shall note this registered status, as appropriate. This includes: (a) expressing the ENERGY STAR name in all capital letters (It is also appropriate to use a slightly larger point size for the first letter of each word, e.g., twelve point for the E and S, and ten point for the other letters.), and (b) including the registered symbol,® , *each time* the ENERGY STAR name or logo appears in a brochure, poster, advertisement, or other document (i.e., ENERGY STAR® ). The registered mark statement "ENERGY STAR is a U.S. registered mark" may also be used *in addition* to the registered symbol to indicate the registered status of the mark. **See Guidelines for Proper Use of the ENERGY STAR® Name and International Logo (Attachment A).**

E. Endorsement
Under no circumstances shall the ENERGY STAR name or logo be used in a manner that would imply EPA endorsement of the Partner, its products or its services.

F. Altering Logo
ENERGY STAR Partner agrees not to alter the ENERGY STAR logo except in the ways described in the **Guidelines for Proper Use of the ENERGY STAR® Name and International Logo (Attachment A).**

G. Termination of Agreement
If either EPA or Partner terminates this Agreement, Partner will no longer be entitled to apply the ENERGY STAR logo to newly manufactured products, and will no longer make reference to the ENERGY STAR Program so as to construe continuing involvement in the program. Any products bearing the logo that have been shipped by the Partner prior to program termination, and are no longer in the Partner's possession (e.g., products on display or inventoried by retail stores or distributors), may continue to bear the logo.

## VII. Conflict Resolution

A. Good Faith Principle
Each party agrees to assume good faith as a general principle for resolving conflicts under the ENERGY STAR Program.

B. Notification of Problems
Both parties agree to notify each other informally if any problems or issues arise and to work together to provide maximum public confidence in the program.

C. Procedure for Addressing Non–Compliant Products

1. If EPA receives information that one or more products certified by Partner as ENERGY STAR–compliant may not meet all of the terms of this MOU, then EPA will immediately notify Partner and attempt to address and resolve the problem informally.

2. If these informal discussions do not produce a mutually agreeable resolution, EPA shall notify Partner in writing that Partner shall be terminated from the ENERGY STAR Program unless it undertakes the specific corrective actions sought by EPA. Partner agrees to reply to EPA in writing within 20 business days of receiving EPA's letter. At that time, Partner shall agree to do one of the following: (a) undertake in a timely and effective manner, the corrective actions sought by EPA; or (b) voluntarily terminate this agreement. If Partner does not respond to EPA's letter within 20 business days, or responds but does not agree to either (a) or (b), then this agreement is terminated.

D. Notification in Writing
If ENERGY STAR Partner believes that EPA is not meeting all of its commitments, Partner agrees to notify EPA formally in writing. EPA agrees to respond in writing within 20 business

days of receiving ENERGY STAR Partner's letter. At that time, EPA will do one of the following: (a) undertake the corrective actions sought by Partner, or (b) explain why such corrective actions cannot be undertaken.

## VIII. Freedom of Information Act and Confidential Business Information

Both parties understand that information provided by Partner to EPA will be treated pursuant to EPA's public information regulations under 40 Code of Federal Regulations, Part Two.

*  *  *  *  *

The undersigned hereby execute this Memorandum of Understanding on behalf of their parties. The signer of this agreement affirms that he/she has the authority to commit Partner to participation in the ENERGY STAR Office Equipment Program.

**For the U.S. Environmental Protection Agency (EPA):**

*----draft----draft----draft----*  *----draft----*

Signature: _____ Date: _____

Name: Paul M. Stolpman

Title: Director, Office of Atmospheric Programs

**For [Company]:**

*----draft----draft----draft----*  *----draft----*

Signature: _____ Date: _____

Name: _____

Title: _____

**ATTACHMENT B:**
**APPOINTMENT OF LIAISONS**
***ENERGY STAR Printer/Fax/Mailing Machine MOU (Version 3.0) – Draft 1***

Please complete and return with the signed Memorandum of Understanding.

EPA Contact:

Andrew Fanara, Program Manager
ENERGY STAR Office Equipment Program
US EPA (MC: 6202J)
401 M Street, SW
Washington, DC 20460

**Overnight Delivery Address:**
Andrew Fanara, Program Manager
ENERGY STAR Office Equipment Program
501 3rd Street, 4th Floor, NW
Washington, DC 20001
(202) 565-9019

[Company] Contacts:

Primary Contact (To receive all materials):

Name:
Title:
Address:
City, State, Zip:
Telephone Number:
Fax Number:
E-mail Address:
Headquarters located at (if applicable):

Marketing Contact (To receive marketing and communications materials):

Name:
Title:
Address:
City, State, Zip:
Telephone Number:
Fax Number:
E-mail Address:

Switchboard or main sales phone number (to distribute to public):

Phone number:

Fax number:

**ATTACHMENT C:**
**TESTING CONDITIONS FOR ENERGY STAR MEASUREMENT**
**PRINTERS AND FAX MACHINES**
***ENERGY STAR Printer/Fax/Mailing Machine MOU (Version 3.0) – Draft 1***

In order to eliminate confusion and ensure consistency, the following protocol should be followed when measuring power for printers and fax machines under the ENERGY STAR Office Equipment Program.

Outlined below are the ambient test conditions which should be established when performing the power measurement. These are necessary in order to ensure that outside factors do not affect the test results, and that test results can be reproduced later. A description of the specifications for testing equipment, as well as a discussion of testing issues, follow on the succeeding pages.

## I. TEST CONDITIONS

| | |
|---|---|
| Line Impedance: | < 0.25 ohm |
| Total Harmonic Distortion: (Voltage) | < 5% |
| Input AC Voltage:[4] | 115 VAC RMS +/- 5V RMS |
| Input AC Frequency:[1] | 60 Hz +/- 3 Hz |
| Ambient Temperature: | 25 deg. C +/- 3 deg. C |

## II. TEST METHOD

Printer and fax machine manufacturers should measure and report the **average** power consumption of their printer and fax machine products when in the low-power mode. This should be done by evaluating the printer or fax machine over a time period sufficiently long to include typical variations or surges in power (e.g., any cycling of the fuser). The recommended approach is to utilize a watt-hour meter, and measure the energy consumption in the low-power mode of the printer or fax machine over 1 hour. This will allow manufacturers to capture any variations in power usage that occur during the low-power mode. Dividing the measured energy consumption by the time period over which it is measured will produce average Watts. While this approach will provide the most accurate results, it is not essential to follow this for printers and fax machines whose idle-mode power consumption does not vary (e.g., dot matrix printers, inkjet type printers and fax machines, and laser printers and fax machines where the fuser is turned off during idle mode). For printers and fax machines with constant idle-mode power consumption,

[4] If products will be sold in Europe or Asia, testing should also be performed at the appropriate machine-rated voltage and frequency. For example, products destined for European markets might be tested at 230 V and 50 Hz. The logo should not be displayed on products shipped to Europe or Asia if the equipment does not meet the power requirements of the Program at the local voltage and current conditions.

manufacturers may choose to utilize a high quality watt-meter and take several measurements of instantaneous power.

## III. TESTING EQUIPMENT

The goal is to accurately measure the TRUE power consumption[5] of the printer or fax machine. This necessitates the use of a **True RMS** Watt-Meter or Watt-Hour Meter. There are many watt-meters and watt-hour meters to choose from, but manufacturers will need to exercise care in selecting an appropriate model. The following factors should be considered when purchasing a meter and setting up the actual test.

Crest Factor

A previous version of EPA's testing procedure included a requirement that manufacturers utilize a meter with a crest factor greater than eight. As many Partners pointed out, this is not a useful or relevant requirement. The following paragraphs are meant to discuss the issues relating to crest factor and to clarify the intent of the initial statement. Unfortunately, EPA cannot provide a specific equipment requirement because testing is as much art as it is science. Manufacturers and testers will have to exercise judgement, and draw on people well versed in testing issues, to select an appropriate meter.

It is important to understand that electronic equipment such as printers and fax machines typically draw current in a waveform different from typical sinusoidal current.[6] While virtually any meter can measure a standard current waveform, it is more difficult to select a meter when irregular current waveforms are involved.

It is critical that the meter selected be capable of reading the current drawn by the printer or fax machine without causing internal peak distortion (i.e., clipping off the top of the current wave). This requires a review of the meter's crest factor,[7] and of the current ranges available on the meter. Better meters will have higher crest factors, and more choices of current ranges. When preparing the test, the first step should be to determine the peak current (amps) associated with the printer or fax machine being measured. This can be accomplished using an oscilloscope. A current range must be selected that will enable the meter to register the peak current. Specifically, the full scale value of the current range selected multiplied by the crest factor of the meter (for current) must be greater than the peak current reading from the oscilloscope. For example, if a meter has a crest factor of 4, and the current range is set on 3 amps, the meter can register current spikes of up to 12 amps. If measured peak current is only 6 amps, the meter would be satisfactory. However, if the current range is set too high in order to register peak current, then it

[5] True power is defined as (volts)x(amps)x(power factor), and is typically reported as Watts. Apparent Power is defined as (volts)x(amps) and is usually expressed in terms of VA or volt-amps. The power factor for equipment with switching power supplies is always less than 1.0, so true power is always less than apparent power.

[6] The crest factor for a sinusoidal 60 Hz current waveform is always 1.4. The crest factor for a current waveform associated with equipment containing a switching power supply will always be greater than 1.4 (though typically no higher than 8). The crest factor of a current waveform is defined as the ratio of the peak current (amps) to the RMS current (amps).

[7] The crest factor of a watt meter is often provided for both current and voltage. For current it is the ratio of the peak current to the RMS current in a specific current range. When only one crest factor is given, it is usually for current. An average True RMS Wattmeter has a crest factor in the range of 2:1 to 6:1.

may lose accuracy in measuring the non-peak current. Therefore, some delicate balancing is necessary. Again, with more current range choices and higher crest factors you will get better results.

Frequency Response
Another issue to consider when selecting a watt-meter is the frequency response rating of the meter. Electronic equipment that contains switching power supplies causes harmonics (odd harmonics typically up to the 21st). These harmonics must be accounted for in power measurement, or the Wattage consumption will be inaccurate. Accordingly, EPA recommends that manufacturers purchase meters that have a frequency response of at least 3 kHz. This will account for harmonics up to the 50th, and is recommended by IEC 555.

Resolution
When testing printers and fax machines whose power consumption is close to the ENERGY STAR requirements, manufacturers will probably want a meter than can provide resolution of 0.1 W.

Accuracy
Another feature to consider is the resulting accuracy you will be able to achieve. Catalogues and specification sheets for watt-meters typically provide information on the accuracy of power readings that can be achieved at different range settings. If you are measuring a product that is very close to the 45, 60, 65, or 85 watt ceilings, you will need to set up a test that will provide greater accuracy. For example, if the resulting accuracy for your watt-meter at the test settings is $\pm$ 0.5 W, then with a measured power consumption of $\leq$ 44.5 W you can be fairly sure that your printer or fax machine is compliant.

Calibration
Meters should be calibrated every year to maintain their accuracy.

## QUESTIONS AND ANSWERS REGARDING TESTING PROCEDURES FOR ENERGY STAR PRINTERS AND FAX MACHINES

Q: Are these printer and fax machine testing guidelines mandatory?

A: EPA's testing guidelines are not mandatory, but we will distribute them to outside parties such as buyers and the computer press. Following these guidelines and producing accurate test results will help companies avoid problems with the compliance of their products. You may determine the appropriate level of stringency and accuracy for your own testing based on your specific product. For example, if your printer or fax machine does not contain a switching power supply, then you will not need to be as careful choosing a meter. Also, if you know your printer or fax machine has relatively stable power consumption in idle mode (i.e., the fuser never comes on), then you probably don't need to measure for a full hour. If your fuser cycles occasionally, your power consumption varies, or you are very close to the maximum allowed wattage, you should probably measure for a full hour to get the most accurate results. (The ASTM guidelines for testing include requirements that all measurements be made over a 1-hour time period.)

Q: Where can I find a True RMS watt-meter or watt-hour meter that will meet my requirements?

A: A true RMS watt meter can be ordered from several manufacturers. The EEM catalogue lists about 75 companies under Meters, Watt. Probably only a third of these companies make meters suitable for ENERGY STAR measurement. Some manufacturers that carry watt-meters that may be appropriate include: AMEC, Clarke-Hess, NGI-Norma, Ohio Semitronic, Valhalla, Voltech, and Yokogawa. When you call any of these manufacturers be sure to tell them what you need the equipment for, and request their specification sheets. (As companies find adequate meters, please let me know so I can share them with other Partners.)

Q: Can I assume the voltage coming out of my wall socket is close to 115 V?

A: No. The voltage coming out the wall could easily vary by more than +/- 5 V from the suggested 115 Volts AC. By applying a "resonant" line voltage regulator between the wall outlet and the device under test, the input voltage can be regulated to 115 V $^{+/-}$1%.

Q: Will the voltage coming out of the wall have a harmonic distortion <5%?

A: Not always. However, a "resonant" line voltage regulator will help to regulate distortion to within 3%.